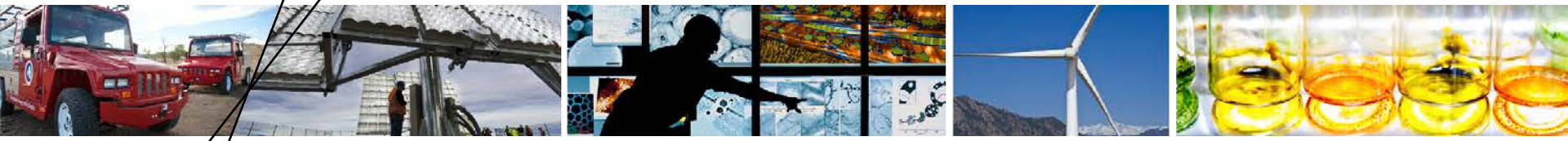
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Utility Participation in the Rooftop Solar PV Market



DG Interconnection Collaborative (DGIC)

January 21, 2016

Justin Orkney
Program Manager of Distributed Generation
Tucson Electric Power (TEP)

Marc Romito
Manager
Arizona Public Service

Logistics

- **Participants are joined in listen-only mode.**
- **Use the Q&A panel to ask questions during the webinar. We will have a few minutes of Q&A between each presentation and group discussion at the very end.**

➢ **To ask a question:**

  - Click Q&A box in the gotowebinar toolbar
  - Type your question in the Q&A box

- **The webinar is being recorded and will be posted on the DGIC web-page - http://www.nrel.gov/tech_deployment/dgic.html**

Agenda (1 ½ hour)

5 *mins*. Overview of DGIC (Kristen Ardani - NREL)

55 *mins.* Informational Webinar:

- "Utility Participation in the Rooftop Solar PV Market"

30 *mins.* Q&A/discussion

DGIC Background and Context

- Supported by U.S. DOE SunShot Initiative
- Formed following stakeholder workshop in October 2013
- Focused on informational exchange and innovation related to distributed PV interconnection processes and practices

- NEW! Utilities can apply for technical assistance on matters that require solar expertise related to topics like programmatic conceptualization, existing program design/redesign, and long-term utility strategic planning.
- Request assistance through the Solar Technical Assistance Team (STAT), fill out the request form. Email this information to stat@nrel.gov. **Deadline is Jan 22, 2016**

SunShot U.S. Department of Energy

DGIC Framework and Activities

Area 1: Practices and Protocols

- Document and understand current practices and approaches
- Identify replicable innovation and consistency

Area 2: Peer Exchange

- Data and information exchange amongst stakeholders
- Informational webinar series
  And
  Technical review committee

Area 3: Technical Assistance

- Free technical assistance through the Solar Technical Assistance Team **(STAT)**
- Contact: stat@nrel.gov

DGIC and Technical Assistance Resources

- **Participate in the Collaborative and shape the discussion by signing up through the DGIC web page, below:**

  http://www.nrel.gov/tech_deployment/dgic.html

- **New! Utilities can apply for NREL technical assistance here:**

  http://www.nrel.gov/tech_deployment/state_local_governments/utility.html

Speakers

Justin Orkney
Program Manager of
Distributed Generation
Tucson Electric Power (TEP)

Marc Romito
Manager
Arizona Public Service

Kristen Ardani
Solar Analyst (DGIC Moderator)
NREL

The Real Line-Side Tap

Justin Orkney – Program Manager
Renewable Energy Resources
January 21, 2016

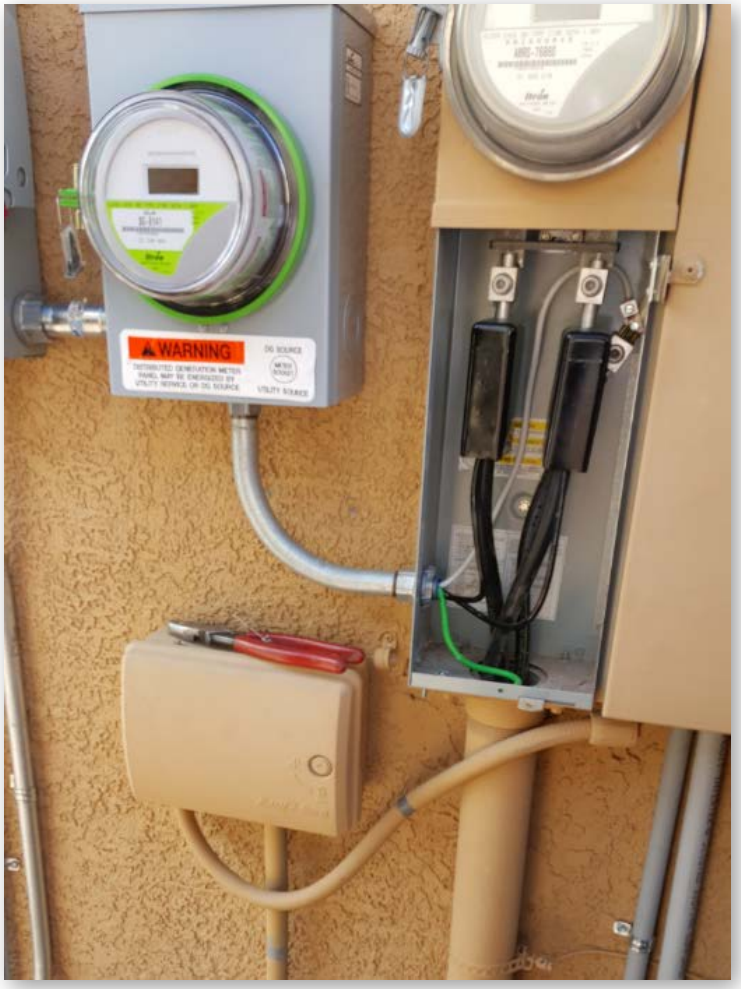
TEP
Tucson Electric Power

Overview

- State of Utility in “Competitive” Marketplace
  - Context
- TEP Residential Solar Program
  - Value to TEP and customer
  - Tariff & bill
- Program Highlights
  - Marketing
  - Customer relationship
  - Materials
  - Installations
- Questions

The Real Line-Side Tap

- Utility-owned residential solar interconnected on the utility-side of the meter



The Electric Utility "Problem"

- **Arizona Renewable Portfolio Standard (RPS)**
  - Requires 4.5% of electric sales to come from renewable Distributed Generation (DG) by 2025
    - Residential & Non-Residential
  - For TEP, this will be roughly 425,000,000 kWh annually of 'behind the meter' generation
  - 20+ MW of residential solar installs each year
    - ~30 MW of residential solar applications in 2015
  - ~15 MW of commercial installs annually

Tucson Electric Power's Solution

- **TEP Owned Residential Solar Program**
  - 2015 Renewable Energy Standard and Tariff (REST) Plan
  - Initial Pilot - $10 million budget, up to 600 homes
    - Requested additional $15 million, 1000 homes as part of 2016 REST Plan
  - ~3.5MW residential solar (2015)
  - A new customer choice from TEP that offers long-term price stability and greater flexibility!

Value to Utility

- Reduce impact of cost-shift to non-solar customers
- System connected to TEP grid on utility-side of meter
- Incorporated into distribution management system
- Maintain visibility in community as leading energy provider
- First significant step away from volumetric rate design
- Retention of customers
- Mitigation of lost revenue between rate cases – Solar Tariff

TEP Owned Residential Solar Tariff

- Available to ALL TEP homeowners in good standing
- Based on previous 12 months total usage - Contracted Usage
  - creates a “price per installed kW”
  - $16.50/month per kW
- Energy price fixed for up to 25 years
  - adjuster at +/- 15% contracted usage
- $250 processing fee once system is complete (covers admin)
- **Regulatory Out – no fee or penalty to exit program and remove system if ACC changes rate**

Value to Customer

- Price security and usage flexibility with solar tariff
- TEP owns, operates, and maintains system at no cost
- Local solar installer support – design and install system
- No FICO credit score restrictions
- Easily transferrable to new home-owners
- No large, out-of-pocket expense
- TEP is a 120 year-old stable, reliable community partner
- Consumer protections - AZ Corporation Commission (ACC)

Example

- Average residential usage on standard rate
- Previous 12 months usage: 11,414 kWh - $117.50/month

VAIL, AZ 85641-2558

R-10-Residential Solar - Company Owned Program (Service No.) 03/17/2015 to 04/16/2015

Solar Fixed Rate	99.17
Renewable Energy Standard Tariff	[illegible]
DSM Surcharge - kWh 951.00 @ $0.002311	2.20
ACC Assessment	0.20
RUCO Assessment	0.03
State Sales Tax	5.87
Regional Transportation Authority Tax	0.52
TOTAL CURRENT CHARGES - Electric Service	111.18
With Rate R01, your Bill would have been:	[illegible]

New Fixed Solar Rate

New Total – Fixed Solar Rate + Taxes

Meter	Unit of Measure	Next Read Date	Current Read Date	Prior Read Date	Days	Current Reading	- Prior Reading	= Reading Difference	x Multiplier	= Usage
AMRS-339176	KWH	5-13	4-16	3-16	31	8250	7740	510	1	510

- New fixed solar rate: $99.17 - Fixed for up to 25 years
- New total monthly payment: $111.18

Program Marketing

- Standard TEP Press Release
- TEP Newsletter – Plugged In
- TEP Website

Relationship with Customer

- Existing Relationship to Build On
  - "We're so glad to have waited for a program like this with TEP, a company we trust and feel comfortable with." – D. Garcia - Tuesday
- Opportunity to Engage & Educate
  - Program Collateral
  - TEP Website

Material Procurement

- Competitive Bid for PV Modules and Inverters
  - REC - TwinPeak Series
    - 270 Watt modules
  - Fronius Primo inverters
    - 3.8, 5.0, 6.0, 7.8
  - Inverters & modules < $1.00/watt

Inventory Management & Distribution

- TEP Materials Management Services
  - ~40 acres of inventory management
  - ~20 different “customers”
    - Internal – Metering, T&D, ect.
    - External – High-Voltage, ect.
  - 40-50 material pick-ups daily
  - Inventory PV modules and inverters

Inventory Storage & Distribution

- Solar Alliance Contractors (ACs)
  - Order & pick-up on per job basis
  - Can “bundle” jobs as needed
  - ACs utilize internal TEP workflow management system

Relationship with PV Installer

- 3 Solar Alliance Contractors – Competitive Bid
  - System design
  - Customer contract execution
  - System permitting
  - Pick up TEP material & supply B.O.S.
  - Install & commission system
    - Includes AHJ inspection
  - Customer point of contact
  - Fixed-unit install fee - $/watt

CUSTOM SOLAR & LEISURE

Solar Solution AZ LLC

TFS
TECHNICIANS FOR SUSTAINABILITY, LLC

Program Summary To Date

- 5,200+ currently on Interest List
- 210 signed contracts
- 60 installations – 6.0kWDC Avg.

- **~$2.25/watt Installed**
  - Customer Acquisition
  - Design & Permitting
  - Equipment & Support
  - Installation & Interconnection

Thank You

Justin Orkney
(520) 745-3328
jorkney@tep.com

Utility Participation in the Rooftop Solar PV Market

Marc Romito
Manager, Renewable Energy Program

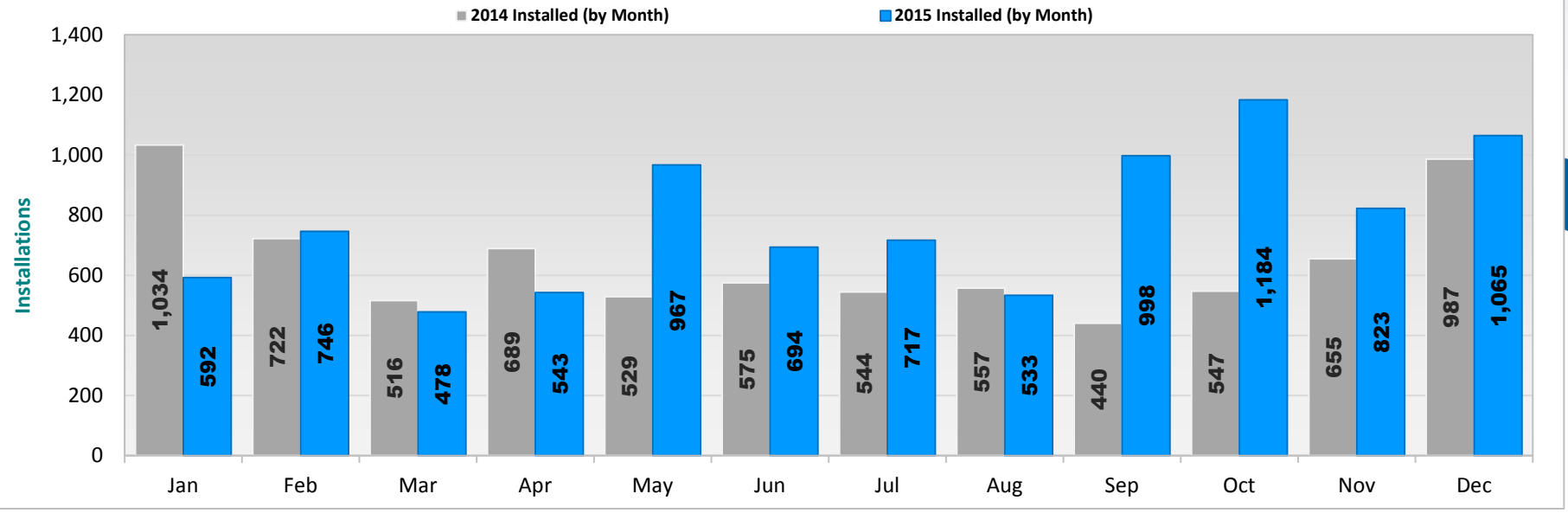
January 21, 2015

aps®

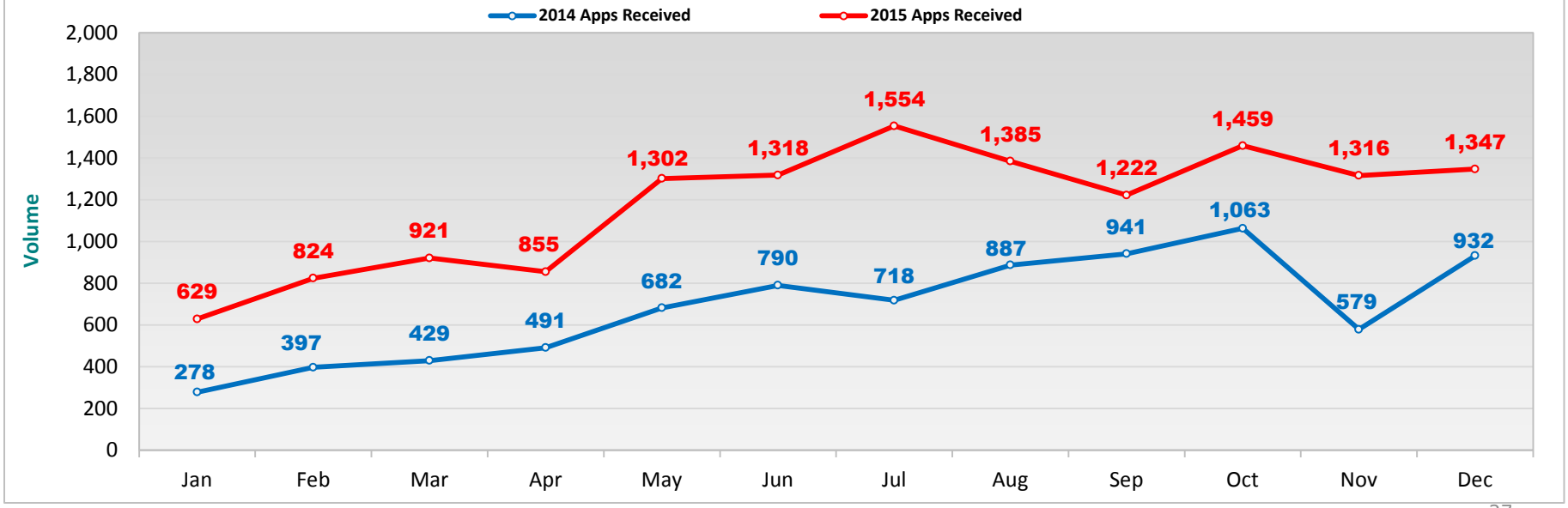
Current State of Rooftop Solar in Arizona

- Record applications/installations YoY
- Impacts to the grid
  - Voltage excursions
  - Operational challenges; reverse power flows, no control
  - Reduced ability to efficiently plan system improvements
- Impacts to customers
    - Cost shift due to net metering
    - Declining ability to add behind the meter technologies

Installations Completed by Month (2014-2015)



Application Volume (2014-2015)



What we are doing about it

- 2016 = R&D/testing year for APS
  - Extremely complex & technical issue
  - Shift from compliance-driven to market determined programs
  - Programs focused on understandings
  - Sustainable outcomes
  - SPP/SIS

Desired End-State: Grid as Enabler

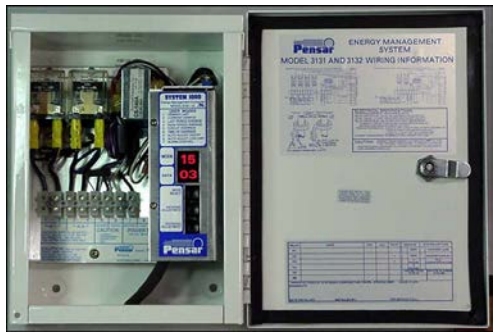
- Monitor/control customer technology impacts
  - Advanced inverters
    - Communications infrastructure – security/resiliency
    - Power quality
    - Curtailment

- Align customer technology with system needs via rate structure
  - Tie Distribution System Planning to available and future customer-sited resources
  - Tie customer Distributed Energy Resources (DER) to Advanced Distribution Management System (ADMS) environment

APS Solar R&D Initiatives

- **Solar Partner Program (SPP)**
  - APS owned rooftop solar research and development program aimed at learning how to efficiently enable the integration of rooftop solar and battery storage with our grid

- **Solar Innovation Study (SIS)**
  - A 75 customer field home energy management and rate research and development program to examine the integration of behind the meter advanced technologies with demand-based rates



Solar Partner Program (SPP)

- Install rooftop solar on 1,500 homes with smart inverters and full 2-way communications to control each rooftop solar site
- Install 2MW of battery storage on 2 selected feeders
- Collect and analyze real time data on energy production, energy usage, power regulation capabilities, and curtailment options

Solar Partner Program (SPP) Benefits

- Proof of ability to actively manage effects of solar by configuring smart inverters and issuing real-time commands in a cyber secure environment
- Validation of ability to mitigate adverse effects of increased photovoltaic (PV) through enhanced power regulating capabilities
- Validation of ability to provide ancillary services from a series of grid-tied batteries in coordination with solar inverters and traditional grid devices
- Collection and analysis of information that helps anticipate, identify and avoid impacts on the distribution grid
- Verification of distribution system models to be used in more accurately and efficiently planning grid upgrades

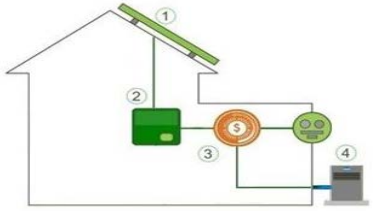
Solar Innovation Study (SIS)

- Implement several combinations of behind the meter technologies that can be used to manage customer demand, shift load, and minimize grid challenges

- Create a rate laboratory to develop modernized demand-based residential rates to align with costs of service

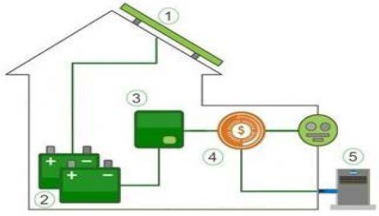
- Utilize integrated technology packages (battery storage, load management, energy efficiency) to modify load shapes to better align with grid needs and future rate structure

50 Homes



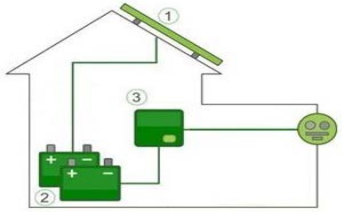
1. Solar PV
2. Smart Inverter
3. HEM/Load Management
4. Multi-stage HVAC

15 Homes



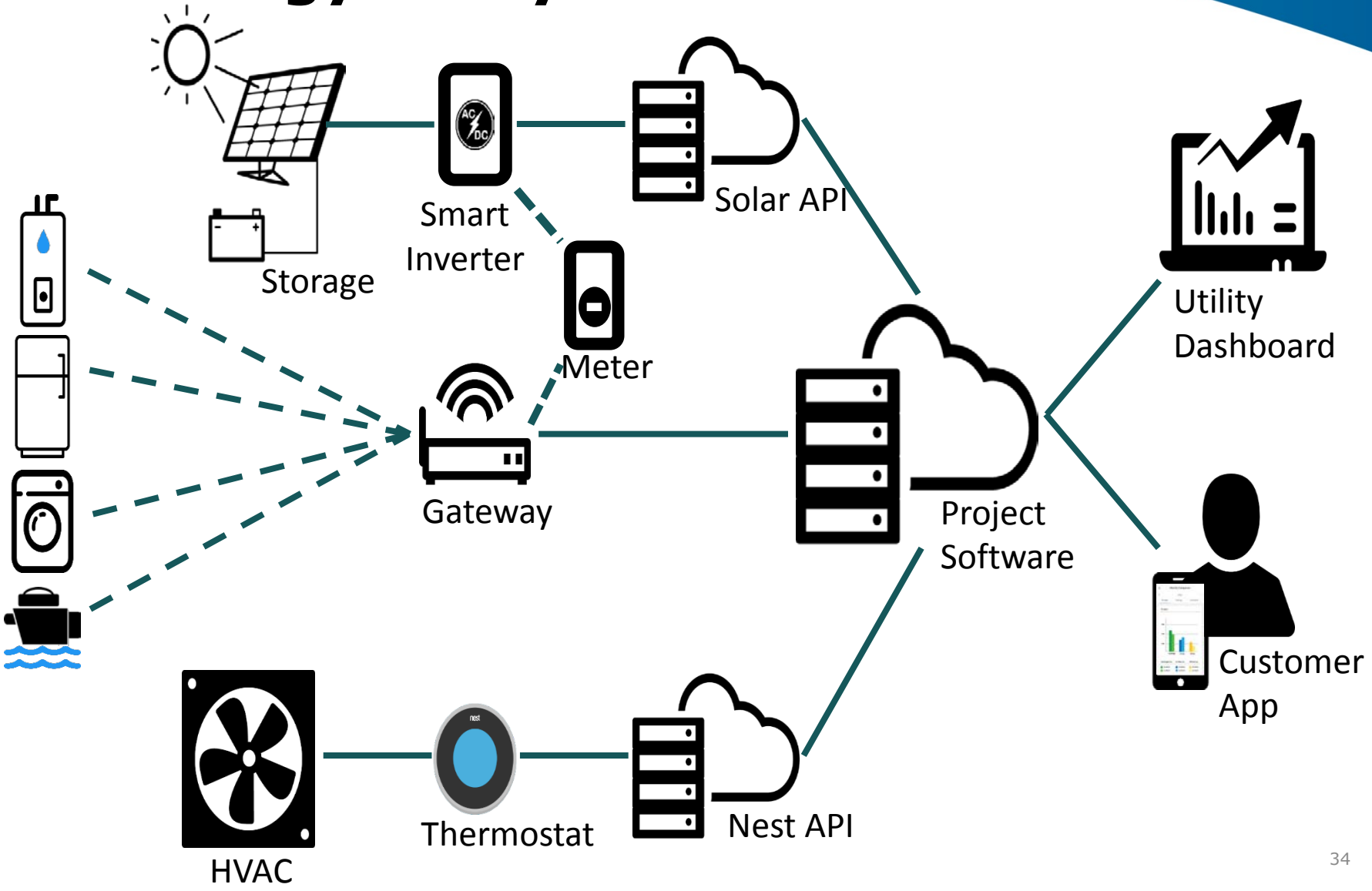
1. Solar PV
2. Energy Storage
3. Smart Inverter
4. HEM/Load Management
5. Multi-stage HVAC

10 Homes



1. Solar PV
2. Energy Storage
3. Smart Inverter

Technology Ecosystem

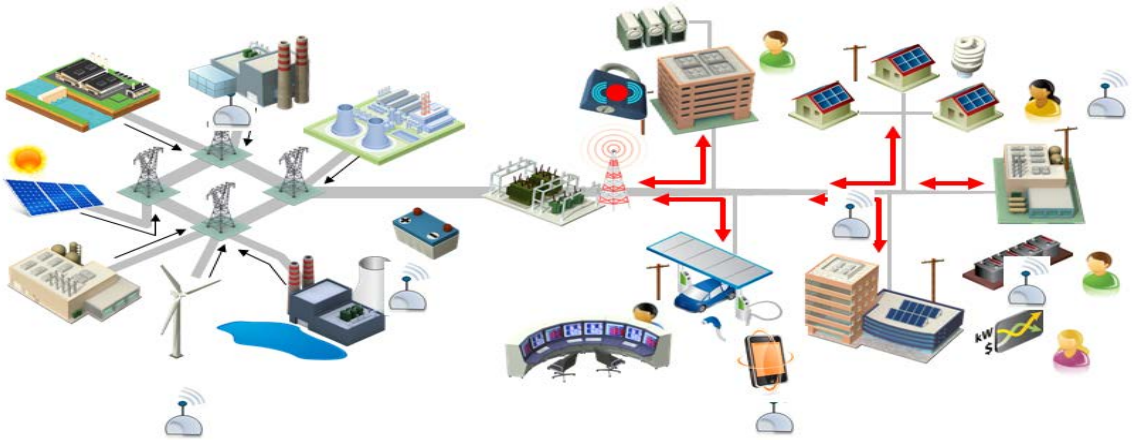


Solar Innovation Study (SIS) Benefits

- Is a win for customers, market, and grid
- Tests ways that enable customers to control their demand
- Explores how DERs interact with each other to facilitate APS's transition to a smarter grid
- Provides data to expand industry-wide knowledge and to maximize use of emerging DERs in today's advanced energy market

Bottom Line

- APS is at the forefront of investigating combinations of solutions to solve current and future grid issues
- Rooftop represents only one subset of the larger distributed energy resource issue.
  - APS is planning for a future that includes solar and the other endless possibilities of DER integration
- APS believes in an enabling grid



Thank you

Marc Romito
602-250-4547
marc.romito@aps.com

DGIC and Technical Assistance Resources

- **Participate in the Collaborative and shape the discussion by signing up through the DGIC web page, below:**

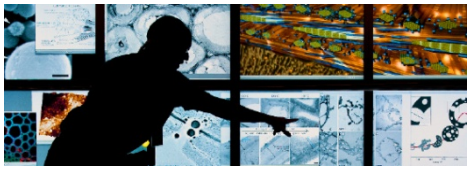
  http://www.nrel.gov/tech_deployment/dgic.html

- **New! Utilities can apply for NREL technical assistance here:**

  http://www.nrel.gov/tech_deployment/state_local_governments/utility.html

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Thank You!

Kristen Ardani
Solar Technology Markets and Policy Analyst
kristen.ardani@nrel.gov